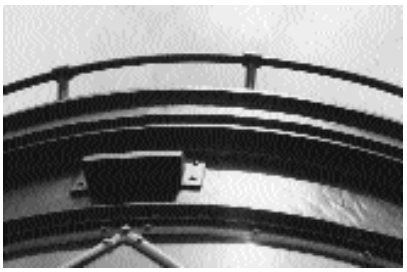
Wayne Truax

Recent Rehabilitation of Anacapa Island Lighthouse

A Case Study

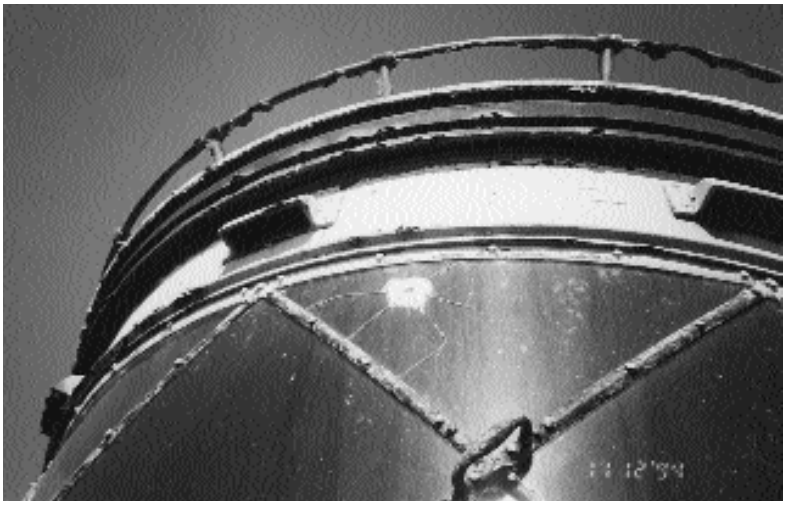


(Below and top right) Close-up of the deteriorated conditions of Anacapa Island Lighthouse before rehabilitation and finished metal work on the lantern after rehabilitation. Photos courtesy USCG.

Anacapa Lighthouse is located on Anacapa Island, 11 miles off the coast of Port Hueneme, California. Built in 1932, it was the last lighthouse built by the U.S. Lighthouse Service. Until the 1995-1996 Coast Guard rehabilitation, Anacapa Lighthouse had never undergone any major repairs.

Determining the Scope of Work

The U.S. Coast Guard Civil Engineering Unit, Oakland's Facility Inspection Team, originally identified the need for this rehabilitation during an inspection of the lighthouse in 1992. The entire lighthouse was in such poor condition



that it was labeled the worst lighthouse on the West Coast. Although most large Coast Guard projects normally take five years before being funded, Anacapa was in such poor condition that it was given a high priority; design work started within two years. In late 1994, the architect assigned to the project made his first site visit. He determined that the best way to repair the badly deteriorated cast-iron lantern house was to remove it from the concrete tower via heavy-lift helicopter and transport it to the mainland for overhaul. Further investigation, however, disclosed several insurmountable obstacles; the architect was forced to consider a more conventional but far from easy onsite rehabilitation of the entire lighthouse. The following scope of work was identified and budgeted for $325,000:

- replace all broken lantern glass;
- replace the missing vent ball with a new fully functional replica cast 304 stainless steel (S/S) vent ball;
- replace the severely deteriorated ladder rails on the lantern room roof with 304 S/S replicas;
- restore the solid bronze lantern room door and lock to a fully operational condition;
- abate all lead and asbestos coatings;
- restore all vents to an operational condition;
- repair all decorative concrete details and structural concrete;
- replace all missing ventilation hoods and covers with historically-accurate replacement parts fabricated from 304 S/S;
- replace the severely deteriorated galvanized iron windows with new galvanized steel windows;
- install new coatings that require minimal maintenance by Coast Guard personnel.

Logistics and Planning

Because Anacapa Island is home to several endangered bird species, the rehabilitation had to take place during the winter months and be completed before the late spring nesting season. The island is difficult to access; all materials had to be brought to and from the site either by boat or helicopter. Transportation costs ranged from $300 per hour for a barge to $500 per hour for helicopter services. Constant changing winter weather, rain, fog, 100 mph winds, and rough sea conditions often ruined the best logistical plans. Some days the landing area for the boat would go from calm at 6:00 a.m. to very rough by 10:00 a.m., forcing the contractor's supply boat to turn around and wait another day. Other days the wind was so strong that materials could not be delivered by boat or helicopter. Since the island was so remote, the workers had no choice but to stay on the island for four days at a time and work ten-hour days.

Everyone learned just how abruptly work could come to a stop when equipment broke down or supplies failed to arrive. There was no quick run to the parts store or to the equipment rental

center. A breakdown was either corrected onsite or the work was delayed until parts could be brought out to fix it. Sometimes the work could be postponed until another scheduled supply run was made to the island. There were a few times, however, when the helicopter had to fly out with nothing but a small part because no one else was coming out to the island for several days. A simple $30 item then cost the contractor $250 in helicopter services.

Dissimilar Metals

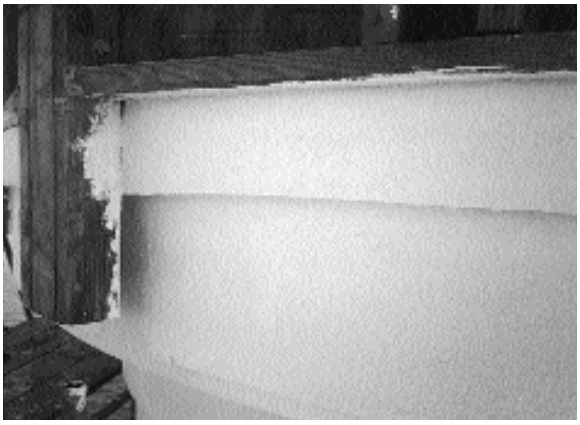
Anacapa Lighthouse did not have damage caused by dissimilar metals; however, a lot of new stainless steel (S/S) replacement parts were introduced and care taken to prevent any future problems. A barrier was applied in all cases where S/S was attached to the cast-iron or bronze areas of the lanternhouse. S/S fasteners were coated with a modern anti-seize compound to prevent galvanic reaction and to take the place of the original white lead. A thick gasket made of roofing felt and coated with a silicone caulk was installed between the new S/S vents, vent hoods, and cast-iron lanternhouse walls. The gasket was made from 15 lb. roofing felt which was inexpensive, easy to apply, and did not crush when the vents were bolted in place. Installing the new S/S ladder rail ring stanchions required a two-step process. First a coat of primer was applied and allowed to dry. Then a heavy coat of primer was applied and the stanchions were installed while the primer was still wet creating a watertight seal. This last step was needed because when the original stanchions were removed, a heavy coat of red lead was found sealing the joint.

On previous lighthouse rehabilitations, broken bolts were replaced with 316 S/S to avoid painting the non-ferrous metal on more recent rehabilitations; however, a bolt that would develop a green patina to match the mullions was selected. All the broken bronze bolts on the lanternhouse window mullions were replaced with marine grade silicone bronze instead of stainless steel. Use of the silicone bronze bolts also removed any concerns of dissimilar metal reaction, and they are equal in strength to stainless steel for this application.

Because the lanternhouse was sealed off from the rest of the tower while being blasted, chemical stripping of the paint could take place on the exterior tower walls and windows. The stripper was water-based and applied by brush and airless sprayer. After soaking for at least 1 1/2 hours, it was scraped off. The stripped area was then neutralized with water and finished with power sanding where necessary. The interior lead-painted walls which were originally only to be lightly scraped and painted were causing problems. The paint was so old and brittle it continually flaked off. The abatement contractor asked for a change order to completely remove the paint because the current finished product was proving to be unacceptable. Chemical stripping of the interior walls had been selected over light blasting to save on the costs of transporting more blasting media to the island. Air-driven needle gun scalers using low pressure air, however, proved to be a more cost-effective method. The paint was so brittle, it shattered when struck by the needles, leaving the concrete virtually paint free. There was no damage to the concrete and only lead paint chips were left to be swept up and disposed of. This method could not be used on the exterior concrete because of the 3/8" white mortar skim coat that had been applied as a finish coat when the light was built in 1932.

After the interior walls were complete, the cast-iron spiral stair case was the last item to be abated. The blaster started at the top floor of the lantern house and backed his way to the front doors. This process took three days and prevented

The rehabilitation of Anacapa Island Lighthouse took place during the winter months, so no repair work could begin until the contractor completed an enclosure around the lighthouse. The enclosure served several purposes: containment of hazardous materials, protection of workers from severe weather, and a dry environment for the repair, prepping, and painting of the lighthouse. The first step in building the enclosure was the erecting of a scaffolding completely around the 30' concrete tower. Next was a weather-tight plywood enclosure for the cast-iron lanternhouse, complete with pitched roof to shed heavy rain. The final step was sealing the scaffolding in heavy shrink-wrap to provide weather protection and containment of any hazardous materials. The entire enclosure phase of the project took two weeks because of difficulties in handling the plywood and applying the shrink wrap in high winds. After the enclosure was complete, all deteriorated metal pieces that were scheduled to be replaced and did not require abrasive blasting were removed. Photos courtesy USCG.



Close-up of the damaged concrete gallery deck after the loose concrete has been removed and before the damaged concrete was repaired using pressure-injected epoxy grout.The finished concrete repair is virtually invisible after the surface has been painted.Photos courtesy USCG.

any other interior work from taking place because of the dust. After the blasting was complete, the entire structure was swept and vacuumed before being rinsed down to remove the remaining dust. The water did cause flash rusting on the newly blasted cast-iron staircase but that was expected and did not pose a problem. All surfaces were then wire brushed, prepped, and primed by a three-man team who only prepped what they could prime within an hour. Although the primer used was designed for use over flash-rust, we did not want to chance a coating failure. Generic paint systems were selected based on durability, performance over minimally prepared surfaces, non-toxicity, and permeability.

Concrete Repair

The 3/8" white mortar finish coat that had been applied over the exterior concrete when the light was built in 1932 was not identified in any of the original drawings. As a result, no one looked during the work site visit for signs of delamination. After the scaffolding was in place, however, several areas were found to be loose between the 10- and 30' elevations. The foreman became concerned that other unidentified delaminated areas would fall out after the job was complete and ruin his work. The foreman inspected the entire tower and found an additional 100 square feet of delaminated mortar. After receiving approval to repair any bad mortar, he personally chipped away all the loose mortar and applied a two-part masonry patch material. The repair work was of such high quality that the patches were unnoticeable when the tower was repainted.

Views of finished lantern and overall shot of the rehabilitated lighthouse. Photos courtesy USCG and NPS.

Of the 12 tower windows, eight required extensive exterior concrete repairs. Rusted rebar had spalled the concrete and caused severe damage. The old rebar was removed, new holes drilled and the new rebar epoxy injected in place. The rebar was then covered, packed, and reshaped with a two-part Sika Flex product.

One major area of concern was the concrete gallery deck located outside the lanternhouse. This deck had considerable damage in two areas without any evidence of the cause. The outer rebar showed signs of corrosion but the damage went 18 to 24 inches deeper into the concrete. Since freezing was not an issue, the cause of the damage was at first unknown. Closer examination revealed signs of an explosion inside the concrete, and we noticed bolt patterns for two old antenna mounts directly above the area. We determined lightning to be the cause. There was no practical way to dig out the broken concrete; the project was already over budget. We decided to do a pressurized epoxy injection and fill all the voids. The area was prepped and pumped full. The outer three inches were left unfilled so the two-part mortar patching compound could be used to restore the damaged area.

Wayne Truax was formerly Chief Warrant Officer with the U.S. Coast Guard Civil Engineering Unit in Oakland, California.